Lower extremity function and slip-resistant surfaces for bathing areas of community dwelling older adults

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Lower Extremity Function and Slip-Resistant Surfaces for Bathing Areas

of Community Dwelling Older Adults

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Abstract

Falls threaten the health and safety of elderly persons. The provision of slip-resistant surfaces inside and outside of the bathing area is recommended clinically by occupational therapists. This study focused on the adequacy of slip-resistant surfaces in the bathing areas of community dwelling older adults. The main hypothesis of this study tested whether there is a correlation between lower extremity function, as measured by The Short Physical Performance Battery (SPPB), and the adequacy of slip-resistant surfaces inside the bathing areas of community dwelling older adults. It should be expected that persons with decreased lower extremity function would especially need slip-resistant surfaces. A total of 60 participants, aged 60 and over and living in homes and apartments throughout Northwest Ohio and Southeast Michigan, were recruited for this study. The point-biserial correlation between the SPPB and adequacy inside the bathing area \( r = -.08, p = .56 \), and the correlation between the SPPB and adequacy outside the bathing area was also low, \( r = .07 \). This suggests that there is little or no relationship between lower extremity function and the adequacy of slip-resistant surfaces inside the bathing areas. Of the 60 participants, only 8 (13%) were found to have no lower extremity dysfunction, as defined by a score of 12 on the SPPB. Of those with lower extremity dysfunction, 31 of 52 (60%) had inadequate surfaces inside the bathing area; 34 of 52 (65%) had inadequate surfaces outside the bathing area. Only 7 participants (12%) of the entire sample had adequate surfaces both inside and outside the bathing area. Secondary analyses revealed no statistically significant correlations between fear of falling and adequate surfaces inside or outside the bathing area, \( r = .06 \) and \( r = -.04 \) respectively. The results of this study indicate that there might be a gap in services for community dwelling older adults regarding education about bathroom safety.
Lower Extremity Function and Slip-Resistant Surfaces for Bathing Areas of Community Dwelling Older Adults

Falling is a major threat to the health and safety of elderly persons. Buchner et al. (1993) defined a fall as “unintentionally coming to rest on the ground, floor, or lower level, while excluding coming to rest on furniture or against a wall or similar structure.” Research has shown that 28-35% of people aged 65 and older have at least one fall each year (Masud & Morris, 2001). After the age of 75, this percent increases to 32-42% (Masud & Morris, 2001). Of the falls incurred by the elderly, 40-60% lead to some type of injury (Masud & Morris, 2001). Elderly people fall for many reasons and under many conditions. To help distinguish the many causes of falls, five main categories have been developed by the Effective Health Care Bulletin. The categories are environmental conditions, medication, medical conditions and changes associated with aging, nutrition, and lack of exercise (Masud & Morris, 2001). In a prospective study performed by Tinetti, Speechley, and Gitner (1988), 336 community dwelling individuals 75 years and older were followed for one year to determine risk factors for falling. Major findings of this study suggested that there was a significant correlation between falls and the following risk factors: cognitive impairment, palmomental reflex, lower-extremity disability, foot problems, problems of balance and/or gait, and use of medication such as benzodiazepines, phenothiazines, and antidepressants (Tinetti, Speechley, & Gitner, 1988).

The National Health Interview Survey, performed in 1997 and 1998, revealed that 55% of injurious falls occurred within the home. According to the Public Policy Institute (2002), the bathtub, shower, or toilet was the site of 4% of all reported injurious falls. However, in a cross-sectional survey by Aminzadeh, Edwards, Lockett, and Nair (2000) of 550 residents of apartment buildings, approximately 32% endured falls, 15% of whom reported the bathroom as the location
of their fall(s). Another study of the location of falls is DeVito et al. (1988), who described a community-based surveillance system for fall injuries among the elderly in Miami, Florida. Through the use of emergency room reports, fire rescue reports, hospital inpatient records, and medical examiner case reports, they found that 58% of injurious falls occurred in the home. Where information was available regarding the specific room within the home where the fall occurred, bathroom falls were reported as the location of 34% of in-home falls (approximately 20% of all injurious falls). These three studies show considerable discrepancy regarding the percentage of injurious falls that occur in the bathroom, but all concur that bathroom falls are common sites for injury. In addition, non-injurious falls were not counted in two of the three studies previously mentioned. Falls that do not require medical attention are still pertinent because they can cause emotional stress, increase the individual’s fear of falling, and act as a prerequisite for additional falls in the future.

Occupations that occur in the bathroom, such as bathing and toileting, are the first occupations of daily living that older adults tend to have difficulty performing as they age (Gitlin, Swenson Miller, & Boyce, 1999). These occupations can sometimes be modified or altered through the addition of assistive devices to allow community dwelling elderly to become as independent as possible. Nelson’s Conceptual Framework of Therapeutic Occupation (CFTO) conceptualizes the importance of assistive devices in the aging population. Nelson defined a person’s occupational form (OF) as “…the objective set of physical and sociocultural circumstances external to the person, at a particular time.” A person’s OF and developmental structure (DS) determine one’s ability to engage successfully in occupational performance (OP). When aging and other physical changes occur within the DS, changes to the OF may be needed. These additions to the OF may include compensatory aids such as assistive devices. When the
OF is modified, increased OP is facilitated allowing the person to become more independent (Nelson & Jepson-Thomas, 2003).

Many assistive devices are available to facilitate occupations in the bathroom. Toileting occupations can be assisted by grab bars, raised toilet seats, and walkers. Bathing occupations can be assisted by grab bars, tub benches, bath chairs, hand-held shower heads, and slip-resistant floor surfaces both inside and outside the bathtub or shower stall. These assistive devices can be used to allow individuals to perform these occupations in a safe and independent manner.

The current study focused on slip-resistant surfaces in the bathing areas of community dwelling older adults. In a study by Gitlin, Swenson Miller, and Boyce (1999), bathroom modifications were performed by an occupational therapist as part of a community-based program to assist frail elderly renters in Philadelphia. Of the assistive devices that were recommended, bath mats for inside the bathing area were the most frequently recommended, with 27 of 34 people receiving this device.

The Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) (1994) defined slip-resistance as “the frictional force necessary to keep a shoe heel or crutch tip from slipping on a walking surface under conditions likely to be found on the surface.” The ADAAG recommended that slip resistance be measured by the static coefficient of friction. However, there is no universally accepted way to obtain accurate measurements of the static coefficient of friction. Additionally, the recommended coefficient of friction for surfaces has been debated due to its unproven ability to prevent falls (National Institute of Standards and Technology, 1996). Without appropriate guidelines and means to measure slip-resistance surfaces, occupational therapists and other assistive technology specialists must make their own informed decisions when trying to prevent slip-related falls in the bathroom. The
recommendations that these professionals make are based on practicality and observations with clients.

One clinically based recommendation is the provision of slip-resistant surfaces inside and outside of the bathing area to reduce slips and falls that can occur while getting into and/or getting out of the bathtub or shower stall. Many different materials can be used that are slip-resistant. Slip-resistant surfaces for inside the bathtub or shower stall include bathmats, adhesive strips, and adhesive appliqués of assorted shapes and sizes (American Occupational Therapy Association, 2004; Lockett, Edwards, Boudreau et al., 2004; The Ohio State University, 1992). It is important to note that these slip-resistant surfaces can be worn from use and need to be checked regularly and replaced when needed. Manufacturers are now developing bathtubs and shower stalls with textured surfaces that increase the coefficient of friction. However, there is no universally accepted way to determine if the texture in these surfaces is adequate. Outside the bathing area, recommended slip-resistant surfaces include wall to wall carpeting, large rugs with rubber backing, or rugs that have been taped or nailed to the floor (Lockett, Edwards, Boudreau et al., 2004; The Ohio State University, 1992). Of the materials listed, different professionals and organizations may prefer one type of surface over another, given that no research has been done to show that one type of surface is safer than another.

Aminzadeh, Edwards, Lockett, and Nair (2000) conducted a cross-sectional survey in Canada of 550 residents, 60 years or older, living in apartment buildings. They reported that 20.6% of the total sample bathed or showered without a bath mat or other slip-resistant surface. Additionally, 27% of participants were found to have loose bath mats outside of the bathing area. The authors considered these potential fall hazards during bathing occupations because they were not secured to the floor. These findings may underestimate the number of older persons who
lack slip-resistant surfaces because approximately 50% of the apartment buildings in this study were designed for older persons with bathroom safety devices in all units.

Roelands, Oost, Depoorter, and Buysee (2002) studied 491 community dwelling elderly in Flanders between 70 and 89 years of age and found that 56.7% owned anti-slip mats. However, of those who did own mats, only 49.5% used their mats regularly while bathing or showering. Reasons for not using a bathmat, even when possessed by an individual, include an aversion to the device, viewing of the device as unnecessary, or forgetfulness in placing the device in the bathing area before bathing or showering. Of those who did not own a mat, 5.7% had no knowledge about the existence or benefits of the device. This research suggests that many community-dwelling elderly do not regularly employ anti-slip equipment to decrease their risk of falling during bathing or showering occupations.

Gillespie et al. (2003) concluded through a systematic review of fall prevention literature that professional recommendations concerning reduction of environmental hazards and increases in lower extremity strength significantly reduced falls. These findings confirm the importance of assessing both the occupational form (features in the home) and the developmental structure (lower extremity strength).

The main hypothesis of this study was to determine if there was a correlation between lower extremity function and the adequacy of slip-resistant surfaces inside the bathing areas of community dwelling elderly. After this correlation was computed the number of persons with lower extremity dysfunction who did not have adequate slip-resistant surfaces was counted. Secondary research questions included determining if there was a correlation between lower extremity dysfunction and the adequacy of slip-resistant surfaces immediately outside of the bathing area. After this correlation was computed the number of persons with lower extremity dysfunction...
dysfunction who did not have adequate slip-resistant surfaces outside the bathing area was counted. Furthermore, it was then determined if there was a correlation between lower extremity function and the adequacy of slip-resistant surfaces inside and outside the bathing areas of community dwelling elderly. The number of persons with lower extremity dysfunction who do not have adequate slip-resistant surfaces inside and outside the bathing area was also counted. Other secondary research questions include determining if there was a correlation between the self-reported number of falls occurring in the bathroom in the past year and the adequacy of slip-resistant surfaces in bathing areas. Additionally, participants’ fear of falling in the bathroom, as determined by the University of Illinois at Chicago Fear or Falling Measure, was analyzed in correlation with the adequacy of slip-resistant surfaces in bathing areas. A further analysis was completed to determine if there was a correlation between fear of falling and lower extremity function. Tertiary interrelationships that were examined include: history of falls and fear of falling, history of falls and lower extremity function, history of injurious falls and fear of falling, and history of injurious falls and lower extremity functioning.

Method

Participants

A parallel study was performed in conjunction with this study to examine these same participants in relation to grab bar adequacy in the bathing areas of community dwelling elderly. Two student investigators collaborated in recruiting 60 participants from local senior centers and churches by posters, verbal communication, and presentations. Participants for this study were recruited based upon the following criteria. Participants had to be aged 60 or older, currently dwelling in a community home or apartment (excluding assisted living), and residing within 60 miles of University of Toledo Health Science Campus. Participants also had to be able to
ambulate without a wheelchair and be able to complete an informed consent form. One person per household was allowed to participate in this study. If there was more than one bathroom in the home, the primary bathing area was the only location examined for adequate slip-resistant surfaces. The participant was required to sign an informed consent before participation. After all observations were made, participants were given brochures, endorsed by the Canadian Association of Occupational Therapists, regarding bathroom safety (Lockett, Edwards, Boudreau, et al., 2004).

See Table 1 for sample characteristics. Among the 60 people who participated in the study, the mean age was 75.6 years ($SD = 9.5$) with 49 females and 11 males. Participants had a mean score of 8.18 ($SD = 2.9$) on The Short Physical Performance Battery with a range of 1 to 12. Of the 60 participants, only 8 (13%) were found to have no lower extremity dysfunction, as defined by a score of 12 on The Short Physical Performance Battery. Over one-quarter of the sample reported falling in the last 12 months, with 15 participants (25%) reporting 1 fall, and 2 participants (3%) reporting more than 1 fall. Seven additional participants (12%) reported a near fall. The location of falls varied with 12 participants (20%) reporting falling on someone else’s property, 3 participants (5%) falling on their own property but not in the home, and 9 participants (15%) falling in their own home. Only two participants reported falling in the bathroom, one of whom fell in the bathing area.

**Instruments**

The Short Physical Performance Battery assessing lower extremity function developed by J. M. Guralnik et al. (1994) evaluates the lower extremity functioning of the participant through side-by-side stand, semi-tandem stand, tandem stand, two timed 4-meter walks, single chair stand, and five timed chair stands. Materials needed for this assessment will include a measuring
tape, masking tape, a stopwatch, a straight backed chair, and a Subject Screening Score Sheet. Guralnik et al. (1994) stated that the Short Physical Performance Battery, which has been administered to more than 5,000 older persons, is “efficient, practical, and safe.” In a 3-year prospective cohort study of 1002 moderately to severely disabled older women, Ostir, Volpato, Fried, Chaves, and Guralnik (2002) found the battery to have excellent test-retest reliability and sensitivity to change. Guralnik et al. (1995) found in a prospective cohort study of 1122 non-disabled community dwelling elderly that the battery was highly predictive of self-reported disability after a 4 year time span. Individuals who obtained lower scores on the initial testing of the performance battery reported a higher level of disability than those who obtained higher scores on the initial test.

The University of Illinois at Chicago Fear of Falling Measure (Velozo & Peterson, 2001) is an interview that rates participants’ fear of falling when performing 16 common occupations. The possible responses include: very worried, moderately worried, and not at all worried. Velozo & Peterson (2001) refined their instrument through Rasch analysis. This analysis provides evidence that the items being measured meet the criterion of unidimensionality. Construct validity was also examined and determined as adequate. A summary fit statistics for persons was performed which concluded that the person separation model was 0.93, while the person separation index was 3.56. The instrument was able to measure 91% of the sample, with 97.2% of all of their responses being valid (Velozo & Peterson, 2001). For this study, the researchers will focus especially on fear of falling while getting in and out of the bathtub.

Procedure

Either of the two researchers was contacted by interested persons through posters and/or presentations at the senior centers and churches. The researchers then set an appointment with
the participant to conduct the research at his or her home. After signing an informed consent form, subjects were asked to provide general demographic information about themselves which included age, gender, and the type of housing in which they currently resided. Participants were also asked to disclose information regarding any types of mobility aids that they used on a regular basis. The researcher then recorded the number of self-reported falls or near falls that participants had in the previous 12 months. Additional information about the fall or near fall was also collected, including the location of the fall(s), the type of fall(s), injuries due to the fall(s), and the severity of any injuries that may have occurred.

The researchers then conducted observations of the bathing area. Each participant was asked before the observation to set up the bathing area as if they were going to take a shower or bath. This was done to ensure that all bath mats were accounted for since bath mats are often removed after bathing to reduce mold and mildew accumulation. To ensure that researcher bias is eliminated, the researcher from the parallel study also observed the surfaces inside and outside of the bathing area. Each researcher observed the slip-resistant surfaces independently, with the researcher of this study always observing the bathroom first, due to the short time needed to assess the surfaces. Each researcher completed a slip-resistance surface checklist during this observation (See Appendix A). The slip-resistance checklist identified what type of slip-resistant surfaces the participants had both inside and outside of the bathing area. The checklist also determined if the slip-resistant surfaces had been installed and maintained properly to ensure that the surfaces were still able to decrease falls. A final score was given to each surface in the bathing area to determine if the surface present was adequate or inadequate. For practicality, the primary focus of this study was the adequacy of surfaces inside the bathing area. This bathing surface could be viewed as most important due to the longer time spent standing on this surface.
It could also be viewed as the surface with more potential for falls due to the increased amount of water on this surface leading to increased slipperiness. For this study, an adequate slip-resistant surface inside the bathing area was defined as: a) a bathmat that securely fits to the surface with suction cups or adequate rubber gripping and does not move when stepped on, or b) adhesive strips/appliqués, of any shape or size, that are rough to touch, have no curling edges, and are securely attached to the flooring. The criterion used to define adequate slip-resistant surfaces inside the bathing area was determined through the published recommendations of professionals and organizations. Bathmats are generally accepted as an appropriate way to reduce slips and falls in the bathing area (American Occupational Therapy Association, 2004; Lockett, Edwards, Boudreau et al., 2004; The Ohio State University, 1992). However, Lockett, Edwards, Boudreau et al. (2004) do not recommend adhesive strips/appliqués as an adequate surface for the inside of the bathing area due to their observations that the appliqués can dry out over time. Adhesive strips/appliqués were considered adequate for this study due to the little research on this topic and the acceptance of this device by other organizations and professionals (American Occupational Therapy Association, 2004; The Ohio State University, 1992). Surfaces inside the bathing area that are textured by the manufacturer were deemed inadequate, when used without a bath mat or adhesive strips/appliqués, due to the inability of the researcher to determine whether the surface creates enough friction to prevent falls. Throughout the literature that has been reviewed, bathtubs with built-in textured surfaces by the manufacturer have not been studied. However, these surfaces were counted on the slip-resistant surfaces checklist.

An adequate slip-resistant surface outside the bathing area was defined in this study as: a) wall-to-wall carpeting without loose rugs, b) a rug with rubber backing that is not applied over carpet, does not have corners or edges that curl up, and does not move when stepped on, c) a rug
that has been taped to the floor that is not applied over carpet, does not have corners or edges that
curl up, and does not move when stepped on, or d) a rug that has been nailed to the floor that
does not have corners or edges that curl up, and does not move when stepped on. Any surfaces
that did not meet this criterion were deemed inadequate. The criterion used to define an
adequate slip-resistant surface outside of the bathing area is consistent with the published
recommendations of professionals and organizations. These recommendations conclude that
hard flooring surfaces, such as tile or laminate, can become slippery when wet. These surfaces,
often found in bathrooms, should be covered with a rug or carpeting that is securely attached to
the floor through nails, tape, or rubber backing to prevent bathroom falls (Lockett, Edwards,
Boudreau et al., 2004; The Ohio State University, 1992).

Results

The main hypothesis tested in this study was the correlation between lower extremity
function and adequate slip-resistant surfaces inside the bathing area. The point-biserial
correlation between these two variables was \( r = -0.08, p = 0.56 \). This suggests that there is little or
no relationship between lower extremity function and the adequacy of slip-resistant surfaces
inside the bathing area. Lower extremity dysfunction was defined in this study as a score of 11
or lower on The Short Physical Performance Battery (SPPB). See Table 2. Of the 60
participants, only 8 (13%) were found to have no lower extremity dysfunction, as defined by a
score of 12 on the SPPB. Of those with lower extremity dysfunction, 31 of 52 (60%) had
inadequate surfaces inside the bathing area.

Table 2 also shows adequacy of outside bathing areas when compared with scores of
lower extremity functioning. A secondary hypothesis to be tested in this study was the
correlation between lower extremity function and the adequacy of slip-resistant surfaces outside
of the bathing area. The point-biserial correlation between these two variables was $r = .07, p = .58$. Of participants with lower extremity dysfunction, 34 of 52 (65%) had inadequate surfaces outside the bathing area. Only 7 participants (13%) of the entire sample had adequate surfaces both inside and outside of the bathing area. Six of these participants had lower extremity dysfunction. Therefore, 6 out of 52 participants (12%) with lower extremity dysfunction had adequate slip-resistant surfaces both inside and outside of the bathing area.

Table 3 illustrates the types of problems that caused surfaces to be deemed inadequate inside and outside the bathing area. The most common type of problem was the total lack of any bath mat or slip-resistant appliqué, as opposed to some type of device that was present but inadequate.

As reported in Table 1, there were 17 participants (28% of 60) who reported falling in the past 12 months. Each of these had at least a mild injury associated with his or her fall, except for one participant. Five participants (8% of 60) indicated a severe injury. Severe injuries reported included joint dislocation or sprain requiring medical intervention, a laceration requiring sutures, and pain requiring medical intervention. See Table 4 for analyses of the relationships between falls and adequacy of non-slip surfaces. Overall, there is little or no relationship between adequacy/non-adequacy of surfaces and falls/no falls history. Of the 17 persons reporting falls in the past year, only 2 had non-slip bathing surfaces considered adequate for both inside and outside the bathing areas. Of the five participants reporting a history of severe falls, all lacked adequate surfaces when considering both the inside and outside surfaces.

Another secondary hypothesis examined fear of falling scores and the adequacy of slip-resistant surfaces inside the bathing areas. The point-biserial correlation between these two variables was $r = .06, p = .63$. The correlation between fear of falling and adequacy of surfaces
outside the bathing area was also very small, $r = - .04, p = .74$. Item 10 of the Fear of Falling measure specifically measure fear of falling getting in and out of the bath. The correlations between this item and adequacy within and outside of the bathing area were $r = - .16, p = .24$ and $r = - .06, p = .65$ (both non-significant and small).

A Pearson correlation of fear of falling in relation to lower extremity functioning was found to be $r = - .54, p < .001$. The correlation is negative because a high score on fear of falling indicates a high level of fear. Tertiary hypotheses involving the relationships between the history of falls, history of severe injurious falls, fear of falling, and lower extremity function were tested by point-biserial correlations. The planned correlations between injurious falls (not necessarily injurious) and other variables were not conducted because all falls except one led to some kind of injury. Histories of falls and severely injurious falls were very weakly related or unrelated to lower extremity functioning, $r = .02, p = .86$, and $r = - .18, p = .16$, respectively. In parallel manner, histories of falls and severely injurious falls were very weakly related or unrelated to fear of falling, $r = .002, p = .99$, and $r = .01, p = .92$, respectively.

Ottenbacher’s percent error rate (PE) was performed on the secondary and tertiary hypotheses to identify the chances of Type I error from multiplicity. There was one statistically significant finding out of a total of ten secondary and tertiary tests, so $PE = 50\%$; therefore the negative correlation between fear of falling and lower extremity function must be treated with some skepticism.

The inter-rater reliability of adequacy versus non-adequacy of surfaces inside the bathing area, using kappa, was determined to be .93. The inter-rater reliability of adequacy versus non-adequacy of surfaces outside the bathing area, using kappa, was determined to be .81. The inter-rater reliability of adequacy of both surfaces versus non-adequacy of one or more surfaces in the
bathing area, using kappa, was determined to be .92. These inter-rater kappa scores suggest that there was large degree of agreement between the two independent raters for all aspects of the slip-resistant surfaces data collection.

Discussion

The purpose of this study was to determine if there was a correlation between lower extremity functioning and slip-resistant surfaces in bathing areas of community dwelling older adults. It should be expected that individuals with lower extremity dysfunction would be more likely to have bathroom safety devices to decrease their chances of falling in the bathroom. However, the results of this study indicate that there is no statistically significant relationship between lower extremity function and adequacy of slip-resistant surfaces both inside and outside the bathing area. Furthermore, analyses of different levels of lower extremity function and non-slip adequacy of bathing surfaces, as in Table 2, show that functional ability does not appear to be related to environmental safety. In other words, there is little or no match between the developmental structure and the occupational form.

Additionally, adequacy of slip-resistant surfaces in the bathing area was not significantly correlated with any of the variables measured in this study. With no relationship between adequacy of surfaces and lower extremity functioning or fear of falling, the researcher is led to question why some community dwelling older adults have adequate surfaces while others do not.

Through conversations with participants we can speculate as to the factors that may determine whether older adults have adequate slip resistant surfaces within their bathroom. First, several participants mentioned that they had added slip-resistant surfaces to the bathing area for their spouses when they had become ill or injured and had never removed the devices even upon enhanced health or death. Also, some participants noted that slip-resistant devices were already
present when they moved into their home or apartment. The presence of slip-resistant surfaces that the participant did not buy for his or her personal safety might well affect the correlation between adequacy and lower extremity functioning.

Another factor identified that influenced the correlation between adequacy and lower extremity functioning included bathtubs and showers that are manufactured with textured surfaces. Surfaces inside the bathing area that are textured by the manufacturer were deemed inadequate, when not used with other slip-resistant devices, due to the inability of the researcher to determine whether the surfaces created enough friction and the absence of support for this type of device in the literature (National Institute of Standards and Technology, 1996). Of the sample of 60 participants, 10 participants had textured surfaces within their bathtub or shower. Many of these participants mentioned that the textured surface protected them from slipping and that they did not want to add bathmats or adhesive strips/appliqués over the surface. Therefore, such a surface inside the bathing area was deemed inadequate even if the participant was pleased with the surface's ability to prevent falls.

The results of this study were less optimistic than the results from the cross-sectional survey performed by Aminzadeh, Edwards, Lockett, and Nair (2000) in Canada regarding bathroom safety devices. Of the 550 Canadians 60 years of age and over surveyed, only 20.6% bathed or showered without a bath mat or other slip-resistant surface. In the current study, 58% of participants (35 of 60) bathed or showered without an adequate slip-resistant surface in the bathing area. It is reasonable to suspect that differences in the reported percentages may be accounted by different definitions of what constitutes a slip-resistant surface inside the bathing area. However, Aminzadeh, Edwards, Lockett, and Nair (2000) identified bath mats as adequate slip-resistant device inside the bathing area whereas this study included not only mats but also
adhesive appliqués as being adequate because of support in the literature (American Occupational Therapy Association, 2004; The Ohio State University, 1992). A more likely explanation for differences in adequacy may be that Aminzadeh et al. conducted their study at apartment buildings where greater than 25% of renters were senior citizens. Therefore, safety devices such as bath mats may have been made available by apartment management.

The results of the Roelands, Oost, Depoorter, and Buysee (2002) study regarding bathroom safety devices found similar results to the current study. Roelands, Oost, Depoorter, and Buysee (2002) studied 491 community dwelling elderly in Flanders between 70 and 89 years of age and found that 56.7% owned anti-slip mats. However, of those who did own mats, only 49.5% used their mats regularly while bathing or showering. Therefore, 50.5% of the sample from Flanders bathed or showered without a bath mat inside the bathing area. This is similar to the percentage of participants in the current study (58%) who bathe or shower without an adequate slip-resistant surface. Again, however, Roelands et al. (2002) counted bath mats as the only type of slip-resistant device in their study.

Only 7 of the 60 participants in this study had adequate slip-resistant surfaces both inside and outside the bathing area. This suggests that community dwelling older adults may not have enough knowledge regarding fall prevention to purchase and install bathroom safety devices. The results of this study imply that there is a gap in health services and an opportunity for occupational therapists to provide community-dwelling older adults with education regarding bathroom safety devices to prevent falls. Occupations of daily living, home safety, assistive devices, community-based services, and fall prevention are areas in which occupational therapists have extensive knowledge. Therefore, occupational therapists are ideal health professionals to educate older adults residing in the community about this topic. Additionally,
occupational therapists should emphasize this education when providing services to clients in rehabilitation settings, such as inpatient and outpatient rehabilitation.

Limitations

There are no universally accepted standards for what constitutes adequate slip-resistant surfaces in bathing areas at this time. Therefore, the researcher had to develop a slip-resistant surface checklist through review of published materials that were mutually inconsistent. The criteria used in this study to determine adequacy may have been too exclusive. Surfaces inside the bathing area that are textured by the manufacturer were deemed inadequate, when not used with other slip-resistant devices, due to the inability of the researcher to determine whether the surface created enough friction (National Institute of Standards and Technology, 1996). If these surfaces had been counted, the number of adequate surfaces inside the bathing area would have increased. Additionally, participants were not asked how they acquired the slip-resistant surfaces that they did possess. Through discussion with participants, it was discovered that many participants acquired devices for other individuals living in their home or the home had come already equipped. This might well affect the correlation between adequacy and lower extremity functioning. Lastly, the participants in this study were all from a similar geographic area and were not racially or socio-economically diverse.

Future Research

It would be important for this study be replicated in other parts of the United States and with a more diverse population of community-dwelling older adults. Perhaps, older adults in other areas of the country are more or less aware of bathroom safety devices. Additionally, it would be important to develop a universally accepted standard of what constitutes an adequate slip-resistant surface both inside and outside the bathing area. Lastly, a tool should be developed
to measure the slip-resistant properties of bathtub and shower surfaces that are textured by the manufacturer to determine if they are adequate to prevent falls in the bathing area.

Acknowledgements

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Table 1

Participant Demographics ($N = 60$). Falls were measured by the subject reporting based on the prior year.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
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</table>
Table 2
Lower Extremity Functioning and Slip-Resistant Surface Adequacy of Bathing Areas as measured by The Short Physical Performance Battery (SPPB) (Scores Less Than 12 Indicate Some Lower Extremity Dysfunction). The point-biserial correlation between the SPPB and inside adequacy was $r = - .08$, $p = .56$, and the correlation between the SPPB and outside adequacy was $r = .07$, $p = .58$.

<table>
<thead>
<tr>
<th>Short Physical Performance Score</th>
<th>Surface Inside</th>
<th>Surface Outside</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adequate</td>
<td>Inadequate</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>11-10</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>9-6</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>5-0</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td><strong>35</strong></td>
</tr>
</tbody>
</table>
Table 3

Identified Problems of Bathing Area Surfaces

<table>
<thead>
<tr>
<th>Inside Bathing Area:</th>
<th>Number Reported</th>
<th>Percent of Inadequate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bath mat has no suction cups or worn rubber backing</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Bath mat moves when stepped on</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Slip-resistant appliqués are smooth to the touch</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Slip-resistant appliqués are curling at the edges</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No bath mat or slip-resistant appliqués</td>
<td>22</td>
<td>63</td>
</tr>
<tr>
<td>Textured built-in tub surface without other device</td>
<td>10</td>
<td>28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outside Bathing Area:</th>
<th>Number Reported</th>
<th>Percent of Inadequate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rug has corners/edges that curl up</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rug moves/slips when stepped on</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Loose rugs over hard flooring</td>
<td>27</td>
<td>69</td>
</tr>
<tr>
<td>Loose rugs over carpeting</td>
<td>12</td>
<td>31</td>
</tr>
<tr>
<td>Hard flooring without slip-resistant device</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 4

Relationships between Slip-Resistant Surface Adequacy and Falls History

<table>
<thead>
<tr>
<th></th>
<th>No Falls</th>
<th>Falls</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In Bathing Area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Inadequate</td>
<td>26</td>
<td>9</td>
</tr>
<tr>
<td><strong>Outside Bathing Area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Inadequate</td>
<td>32</td>
<td>7</td>
</tr>
<tr>
<td><strong>Both Inside and Outside</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Inadequate</td>
<td>38</td>
<td>15</td>
</tr>
</tbody>
</table>
Appendix A

Slip-Resistant Surfaces Checklist for Bathing Areas

Subject #________

I. Adequate Surfaces Inside Bathing Area

Presence of:

___ A secure bath mat with suction cups or adequate rubber gripping that
does not move when stepped on.
___ Adhesive slip-resistant strips or appliqués that are rough to the touch,
not curling at the edges, and are securely attached to the flooring.

II. Adequate Surfaces Outside Bathing Area

Presence of:

___ Wall-to-Wall carpeting without loose rugs.
___ A rug with rubber backing that is not applied over carpet. The rug
does not have corners or edges that curl up. The rug does not move
when stepped on.
___ A rug taped to the floor. This must not be over carpeting. The rug
does not have corners or edges that curl up. The rug does not move
when stepped on.
___ A rug nailed to the floor. The rug does not have corners or edges that
curl up. The rug does not move when stepped on.

III Problems of Bathing Area Surfaces

Inside Bathing Area:

___ Bath mat has no suction cups or worn rubber backing
___ Bath mat moves when stepped on
___ Slip-resistant strips/appliqués are smooth to the touch
___ Slip-resistant strips/appliqués are curling at the edges
___ No bath mat or slip-resistant strips/appliqués
___ Textured built-in tub surface without other slip-resistant device

Outside Bathing Area:

___ Rug has corners/edges that curl up
___ Rug moves.slips when stepped on
___ Loose rugs over hard flooring
___ Loose rugs over carpeting
___ Hard flooring (such as tile or linoleum) without slip-resistant device

IV Final Scoring:

Inside Bathing Area:       ___Adequate       ___Not Adequate
Outside Bathing Area:       ___Adequate       ___Not Adequate
Both Bathing Areas:       ___Adequate       ___Not Adequate